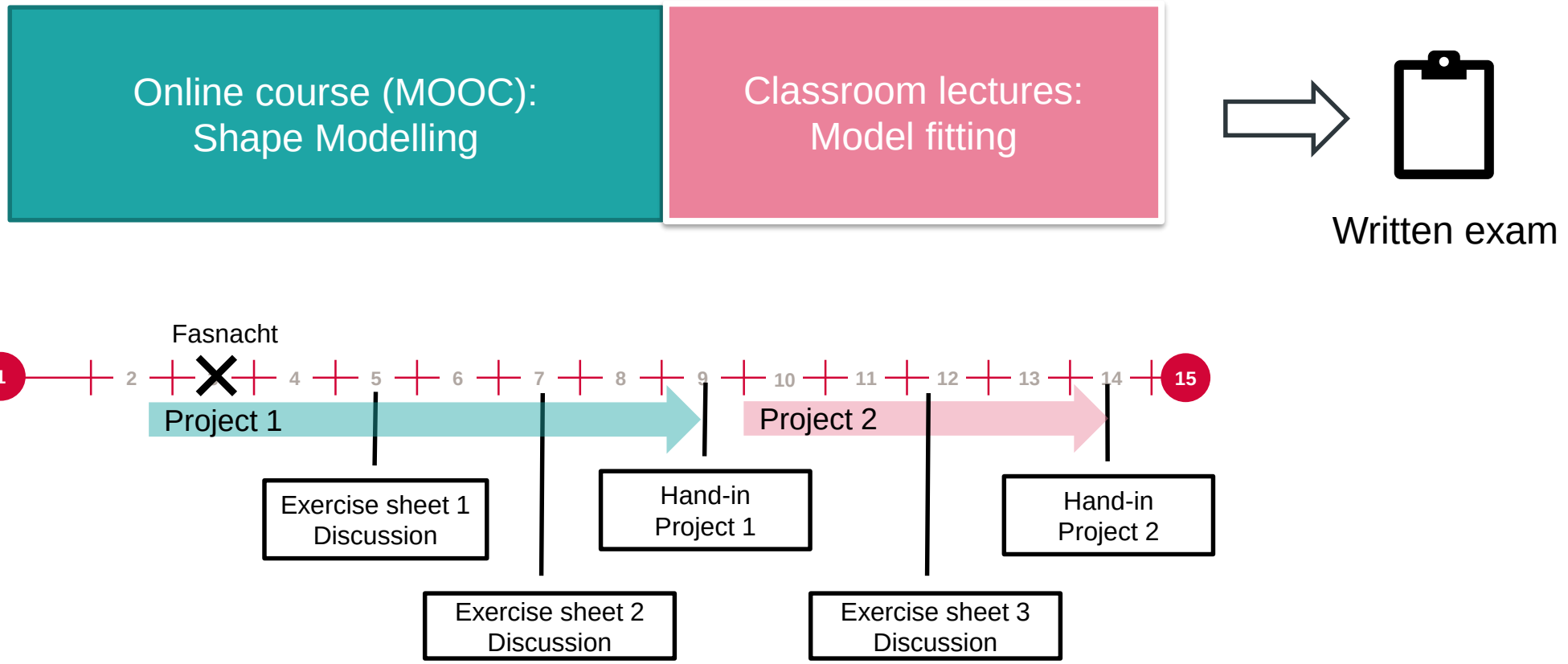
University of Basel

Probabilistic shape modelling

Introduction to the exercises and course project

Marcel Lüthi

Exercises – Milestones - Credits



- Exercises (in groups of 2) will be presented/discussed individually (mandatory)
- Projects count 25 % each to final grade

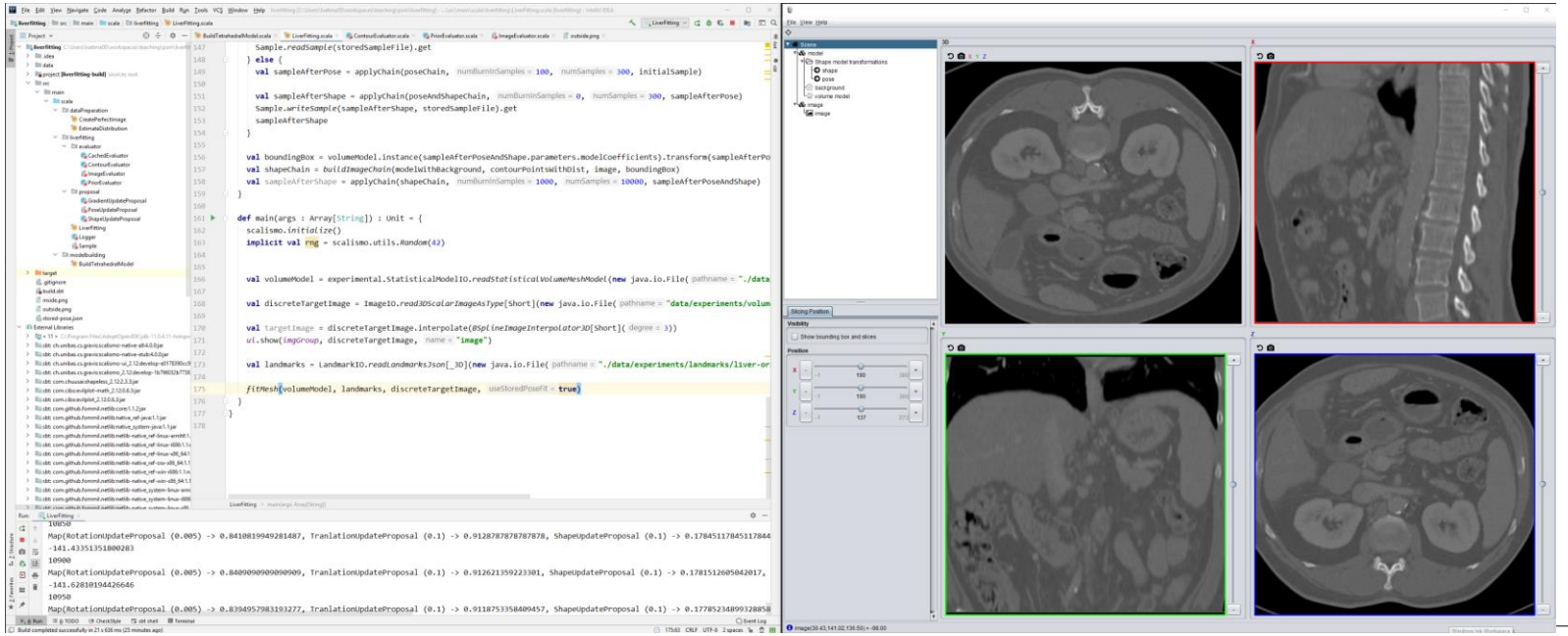
Scalismo vs ScalismoLab

ScalismoLab was built as a teaching tool for non-computer scientists

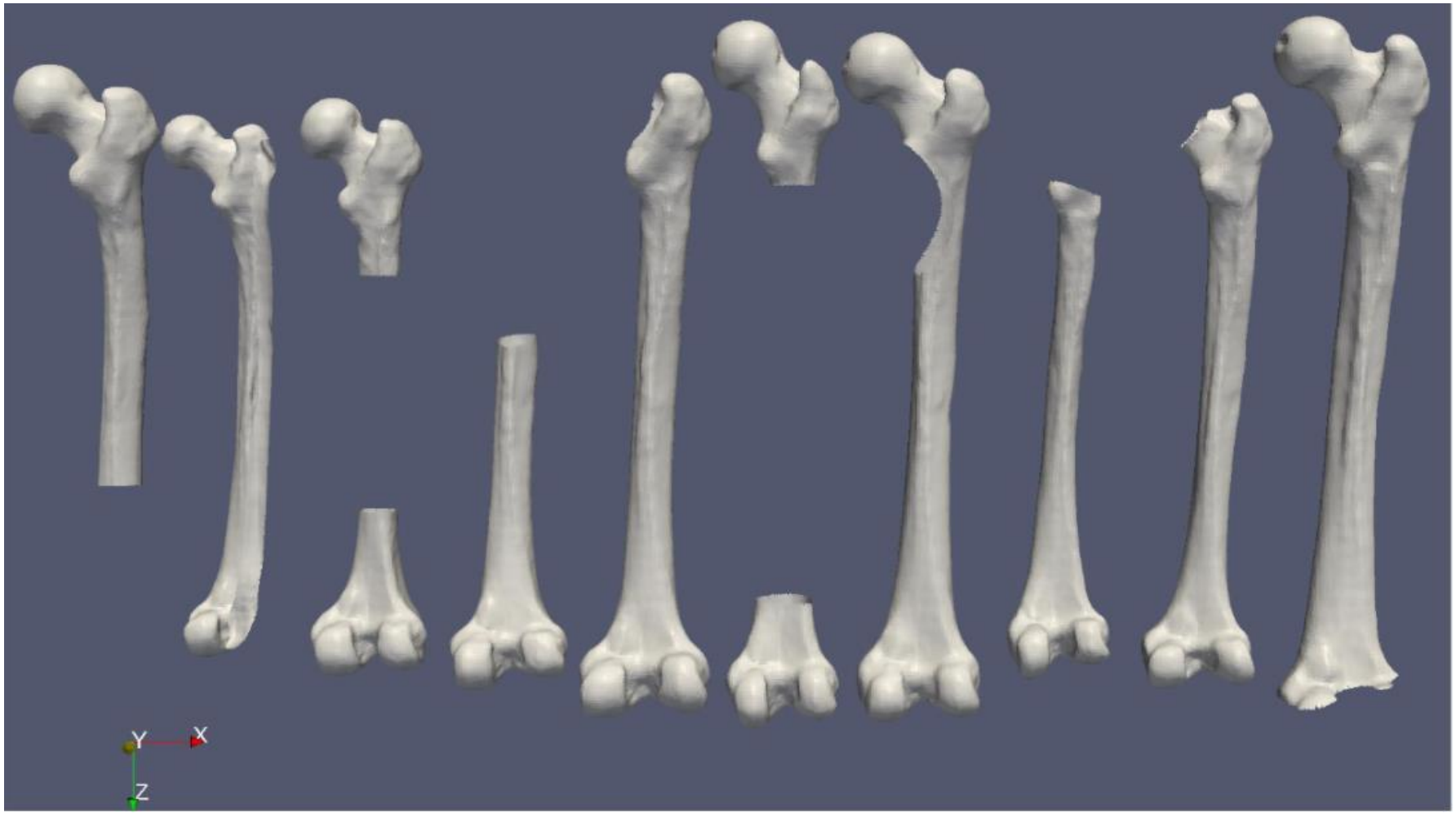
- Stuck on an old version of Scalismo (v0.10)

We will work in an IDE (IntelliJ) and program with Scalismo v0.18

Updated Tutorials: https://scalismo.org/tutorials



Project 1: Reconstruct full femur shape given only parts



Project 1: Milestones

The project is broken up in 3 Milestones

1. Data preparation – Rigid Alignment (Exercise 1)
2. Establishing correspondence and building PCA-Model (Exercise 2)
3. Completion of partial shapes using Gaussian process regression (Project deadline)

- Exercise discussions are mandatory, but not graded.
- Exercises need to be done in group of two

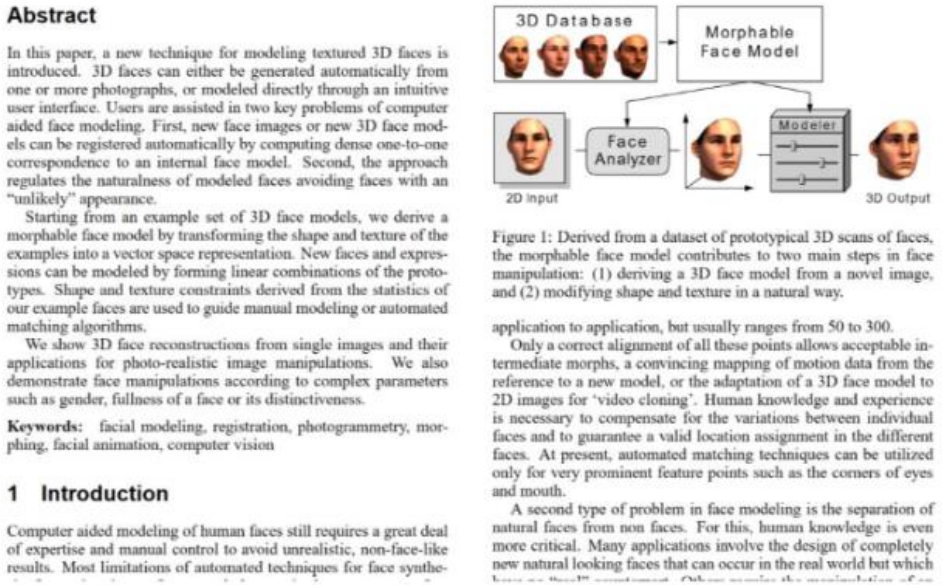
Please send me an e-mail with names of the group members!

Project 1: Form

You need to hand in
- Results
- Code
- **Written report**

Report:
- A mini scientific paper, describing your method
- 3-5 pages long

Evaluation criteria:
- Originality
- Understanding of the theory
- Clarity of exposition
- Results



Abstract

In this paper, a new technique for modeling textured 3D faces is introduced. 3D faces can either be generated automatically from one or more photographs, or modeled directly through an intuitive user interface. Users are assisted in two key problems of computer aided face modeling. First, new face images or new 3D face models can be registered automatically by computing dense one-to-one correspondence to an internal face model. Second, the approach regulates the naturalness of modeled faces avoiding faces with an "unlikely" appearance.

Starting from an example set of 3D face models, we derive a morphable face model by transforming the shape and texture of the examples into a vector space representation. New faces and expressions can be modeled by forming linear combinations of the prototypes. Shape and texture constraints derived from the statistics of our example faces are used to guide manual modeling or automated matching algorithms.

We show 3D face reconstructions from single images and their applications for photo-realistic image manipulations. We also demonstrate face manipulations according to complex parameters such as gender, fullness of a face or its distinctiveness.

Keywords: facial modeling, registration, photogrammetry, morphing, facial animation, computer vision

1 Introduction

Computer aided modeling of human faces still requires a great deal of expertise and manual control to avoid unrealistic, non-face-like results. Most limitations of automated techniques for face synthe-

Figure 1: Derived from a dataset of prototypical 3D scans of faces, the morphable face model contributes to two main steps in face manipulation: (1) deriving a 3D face model from a novel image, and (2) modifying shape and texture in a natural way.

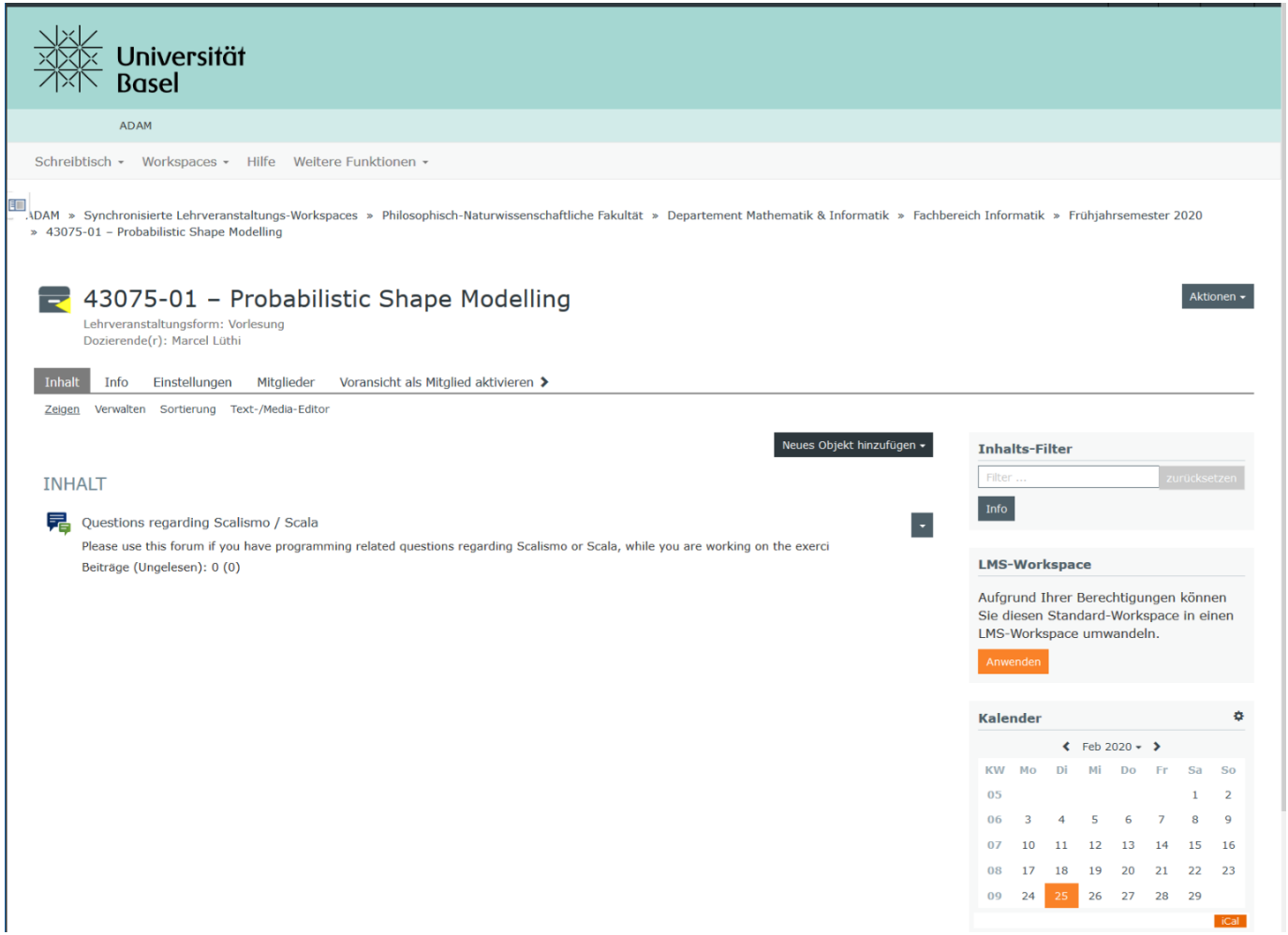
application to application, but usually ranges from 50 to 300.

Only a correct alignment of all these points allows acceptable intermediate morphs, a convincing mapping of motion data from the reference to a new model, or the adaptation of a 3D face model to 2D images for 'video cloning'. Human knowledge and experience is necessary to compensate for the variations between individual faces and to guarantee a valid location assignment in the different faces. At present, automated matching techniques can be utilized only for very prominent feature points such as the corners of eyes and mouth.

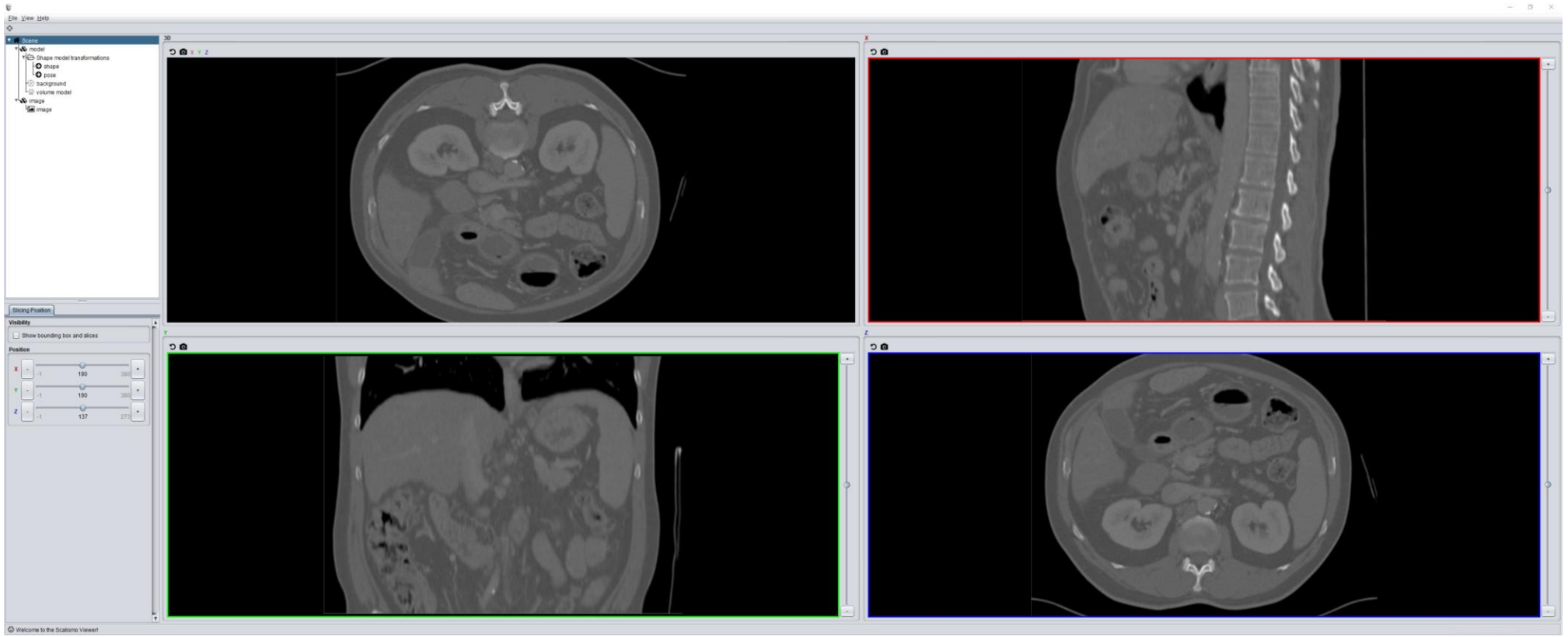
A second type of problem in face modeling is the separation of natural faces from non faces. For this, human knowledge is even more critical. Many applications involve the design of completely new natural looking faces that can occur in the real world but which

Forum

- Please use the forum on Adam for questions regarding the exercises or Scala/Scalismo



Project 2: Semi-automatic segmentation of a liver from CT-Data



Shape model for the liver will be given.

Project 2: Milestones

The project is broken up in 2 Milestones

1. MCMC Fitting to manual annotations (Exercise 3)
2. Incorporating image intensities (Project deadline)

Submission and evaluation is the same as for project 1

Questions?